Food Science: Past Present and Future

The 1976 W. O. Atwater Memorial Lecture

AGRICULTURAL RESEARCH SERVICE · U.S. DEPARTMENT OF AGRICULTURE

The W. O. Atwater Memorial Lecture was established in 1967 by the Agricultural Research Service to give special recognition to individuals who have made outstanding contributions to a field of science broadly related to human nutrition, or advanced public understanding of the role of science in meeting world food needs. Through the Lectureship, ARS seeks to affirm the importance of science in furthering human progress.

Lecturers are chosen from nominations submitted to a formal selection panel established by the Department. Nominations are obtained from scientific societies and other professional associations, foundations, universities, and previous lecturers. Each platform is selected to provide a distinguished audience, and to promote an exchange of ideas among leaders in the scientific community. The texts of these lectures frequently are reprinted in popular and professional publications.

Wilbur Olin Atwater was a gifted scientist whose many basic contributions in nutrition have helped to improve man's welfare. He was a many-sided man—a scientist as well as a research administrator, a teacher, writer, and deeply concerned human being. He established the science of modern human nutrition in the United States, and directed the first nationwide program of human nutrition research, centered in the U.S. Department of Agriculture. Throughout his lifetime, Dr. Atwater exerted every effort to popularize scientific findings in nutrition and to improve people's eating habits and their health.

The 1976 W. O. Atwater Memorial Lecture

Presented in cooperation with
the American Chemical Society
at their Centennial Meeting
New York City
April 5, 1976

Food Science: Past Present and Future

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I have known about the prestigious Atwater Memorial Lecture since it was established in 1967 by the Agricultural Research Service, in recognition of the fields of science that have contributed so much to the improvement of human nutrition, and too, the advancement of public understanding of problems involved in meeting world food needs.

It is needless to say that today this is more important than ever. Chemistry, of course, has always played an important role in advances made in the fields of food and nutrition.

Atwater's Legacy

During my student days, many references were made to the work of Dr. W. O. Atwater in nutrition and his contributions to all of agriculture. In line with this, Dr. J.

George Harrar in his Atwater Lecture said it so well when he stated that Dr. Atwater:

> *. . . embodied a fortunate combination of scientist and humanist; one who saw both the need and the opportunity to make science function effectively in behalf of the well-being of mankind. With a basic interest in agriculture and its role in human nutrition, Atwater effectively wedded his scientific and humanitarian concerns.*

Then again, Dr. William J. Darby in his Atwater Lecture pointed out that in 1887 the Hatch Act established an office of Experiment Stations in the Department of Agriculture, of which Atwater became Chief, one of his great accomplishments. It was at this time that the seeds for the evolution of the fields of nutrition and food science were sown.

Later, Dr. Harvey W. Wiley, a chemist in the Department of Agriculture and one of the first great pioneers in the field of food chemistry and toxicology, worked hard for the establishment of a Pure Food and Drug Act, which became a reality in 1906. Wiley was the first to use a so-called "poison squad" with a number of volunteers from the Department of Agriculture who served as subjects for human toxicological research. An agricultural chemist in the Department of Agriculture, therefore, was the first in the United States to be concerned about the safety of foods and food additives. This great man, with the support of the Department of Agriculture, developed the organization we now know as the Food and Drug Administration.

It is apparent that the Department of Agriculture did much to develop the early interest in foods and nutrition and has continued to be active in these areas throughout the years to the present time. The early development of food science as

a field of study paralleled the evolution of the food industries in the United States, particularly those industries concerned with canning and dairy products. This is described so well by Bitting in a book published in 1937 entitled, *Appertizing or the Art of Canning.*

Food Spoilage Studies

Food science and technology first found its way into universities as a result of spoilage problems. As a matter of fact, as soon as the canning industry started to evolve in the United States, problems developed, and university scientists were called on to help. The first to help were H. L. Russell of the University of Wisconsin and Samuel C. Prescott of the Massachusetts Institute of Techology. Both scientists studied the microbial spoilage of canned corn, the nature of the organisms involved, and the use of proper sterilization techniques. Their early studies were done between 1895 and 1900.

Later, Andrew Macphail, a professor of history of medicine at McGill University, studied the discoloration of canned lobster. When he published the results, Bitting reported,

> *This paper is all the more remarkable, since it presents a combined bacteriological and chemical study on the same product, the first of its kind ever reported.*

So here we have not only microbiology but also chemistry involved in the slowly developing field of food science.

The Underwood Company in Massachusetts experienced spoilage losses. Prescott studied the problem, and determined the cause and its solution. As a result of this experience, he soon saw the need for teaching in this area and proceeded to

develop courses of instruction in the Department of Biology at the Massachusetts Institute of Technology.

As time went on and early in the 20th century, Professor W. V. Cruess, a chemist at the University of California, became interested in enology, the art and science of winemaking. He applied his chemical talents to the improvement of California wines and to the development of courses in the art and science of winemaking. This work, however, terminated when prohibition became a reality. Rather than giving up in despair, Cruess turned his energies toward the development of courses in food chemistry, food preservation, food microbiology, utilization of surplus crops, and toward solving problems relating to the canning and drying industries of California.

Teaching New Science

At the Oregon State University, Professor Ernest Weigand, a horticulturist, early in his career was faced with difficulties relating to the production of maraschino cherries and freezing berries. His attempts to solve these problems eventually resulted in the development of a teaching and research department concerned with horticultural products.

Teaching in dairy science actually preceded food science and technology as we know it today. The reason for this was that there were many small creameries throughout this country that needed for research and teaching personnel to work in them. It is ironic that as time went on, however, this need decreased as a result of growth and diversification of the dairy industry. Many colleges developed new teaching departments in food science and technology independent of those concerned with the dairy science and dairy products, though eventually the trend has been toward combining these two fields.

This new field did not evolve easily or gracefully, however. Scientists in other departments of agriculture looked down upon this new area of investigation. For some reason or other, it was perfectly scientific, respectable, and acceptable to work in the area of soil science and fertilization, including the use of manure, but not in a field concerned with the food we eat. As a matter of fact, when I first entered this field, I was termed by a soil scientist concerned with fertilization, a "jam-and-jelly scientist." This attitude, I can assure you, has changed.

The pioneers in the field of food science and technology in the Department of Agriculture, in the universities, and in industry were remarkable individuals indeed. They had no orientation, and they had no opportunity to develop a point of view. Their training and experience were almost entirely limited to the basic sciences of chemistry and bacteriology and, at times, to one of the production fields. They realized there was a need, and their zeal, energy, and imagination enabled them to develop a new area of teaching and research. The breadth of thinking, however, was quite narrow, and a prevailing view was that food science and technology started at the time raw material reached the processing plant and ended when the processed product left the plant. This is certainly not the situation today.

Coming Of Age

As time went on there were other influences. World War I and especially World War II demonstrated clearly the need for food scientists and teaching in the field. It was difficult, for example, for the Quartermaster Food and Container Research Laboratory at Chicago to find scientists adequately trained in food science to meet its needs.

It was during this period that food science really came of

age, for it was during this period that the importance of food science in the war effort became so well recognized. In fact, it was the the Quartermaster Laboratory in Chicago that many new ideas evolved. For example, the concepts of acceptability, utility (convenience), stability, nutritive value, mobility, and safety were conceived and pursued. These concepts are followed today and are certainly given serious consideration by industry in processing and especially in developing new products.

The Armed Forces had a great need for products that were convenient, safe, and easy to ship. They had a great need for new and effective packaging—a field then quite strange to the food scientist. In addition to the development of new products, there was pressure for new technologies, engineering applications, and so on. It became apparent that the food scientist had to expand his views and no longer could limit his area of interest solely to what took place in a processing plant. It became apparent that he had to consider the product after it left the processing plant—the ease with which it could be transported and distributed, its stability during handling and storage, and factors relating to safety, nutritive value, convenience, and especially acceptability. The last, of course, involves color, texture, taste, and odor. It includes even the noise one makes when eating crisp foods, such as potato chips or celery, and the pain one feels when eating a so-called "hot food." The interest of food scientists, therefore, expanded and ranged from the processing plant to the consumer, and included everything in between.

During the early movements of people to the cities some 50 years ago, those who moved were quite contented to secure most any type of processed food and, generally speaking, accepted it. Today, however, the situation is quite different for consumers no longer accept with gratitude what is made available to them, despite the efforts of the food processor. On the contrary, they often regard food products with

mistrust and suspicion, which is unfortunate. The consumer is concerned about quality and all that quality means: color, texture, flavor, general appearance, convenience, stability, nutritive value, and, above all, safety. The food industry today is well aware it cannot make a single mistake with respect to factors of quality and especially with respect to safety, for if it does a whole organization or even an industry and its many products may be subjected to severe criticism.

Consumer Safety And Nutrition

In speaking of safety, the food scientist today must even be aware of the great and increasing concern about cancer. The publicity about carcinogenesis is fearful and alarming. So much of it seems to relate to the environment, and food and agriculture are certainly components of the environment.

This is the situation today even though the incidence of cancer, except perhaps lung cancer, seems to be leveling off or even decreasing in some instances. Today the food scientist must maintain an intense interest in potential causes of cancer, which includes all aspects of foods from production to consumption. He must be well informed on intentional and incidental additives for he is the one who is responsible for the wholesomeness of a food.

The origin of raw materials and the use of pesticides have attracted a great deal of attention as potential carcinogens, teratogens, and even mutagens. Foods often do contain residues from pesticides or other chemicals. Even though they may meet the tolerances established by the government, these tolerances can and have been changed suddenly and frequently. It means that a food scientist must not only know what is in or on his product, but he must also know and watch for the many rules, regulations, and judgments that continue to pour out of the many governing agencies and the

courts. He must, therefore, know what is applied to raw materials and why, and he certainly must be aware of what takes place on the farm insofar as the use of pesticides and other treatments is concerned.

He must have an understanding of the treatment of dairy animals with penicillin for residues may occur in milk whether or not they exceed the established tolerance, and above all, he must be familiar with the procedure used for analysis for even this may be and has been changed suddenly. Then again, he must know whether diethylstilbestrol has been used as a growth stimulant although such use is now outlawed. It is clear that the interest of the food scientist, therefore, has been greatly expanded to include the source and nature of raw materials, processing, distribution, consumer acceptance, safety, nutritive value, and even nutritional labeling.

I have had a great deal of exposure to the trials and tribulations of the food industry and its problems relating to food safety. It appears to me that often industry scientists have been unaware of what is really expected of them with respect to the safety testing of foods, what protocols to use, and what is meant by teratogenesis, mutagenesis, and even carcinogenesis. This is more the result of governmental uncertainties than neglect on the part of food scientists. The question has been and is what to do about these matters and where one might obtain information, for frequently there has been a lack of agreement in Government and even a lack of knowledge with respect to what protocols to follow in testing for these effects.

Now we hear about allergies and especially hyperkinesis and the question is what to do about them. This problem is a matter of concern today, for it has been stated that certain food colors and flavors are responsible for hyperactive children. However, this statement has not been substantiated by double-blind tests.

I mentioned nutrition, which is a very important area that requires a thorough knowledge of new discoveries and actions especially in the area of fortification and labeling. W. B. Murphy, former president of the Campbell Soup Company, stated at a conference on nutrition held at Rutgers University in 1972 that one of the most perplexing and unsolved problems in the lives of people is the lack of sound knowledge of nutrition and sound eating habits. He went on to point out that there are more than 50 and probably more like 75-possibly even 100-essential nutrients. The minimum of 50 includes the 8 essential amino acids plus the arginine and histidine that are essential for infants; the 15 essential vitamins, and possibly others that may not yet have been discovered; 19 essential minerals including copper, selenium, iron, nickel, tin, zinc, chromium, and others not yet known to be of vital importance. Then, again, there are linoleic, linolenic, and arachidonic fatty acids. We must include water, carbohydrates for calories and bulk, fats for energy and, of course, proteins. In addition, Mr. Murphy mentioned that those in the school food program know full well the importance of psychological and physiological factors involved in acceptance.

Food Technology And The Environment

Now for another area of increasing concern. Environmentalists have certainly made it clear that no issue is isolated and that ecology is certainly a science of interdependence that overflows into the area of food science and technology. This necessitates an understanding by today's food scientist of values and those who judge values. Richard Carpenter, Executive Director, Commission on Natural

Resources, National Research Council, pointed out in a symposium held at Duke University in 1975 that some of the new laws involve many little understood words that are important. Value words or phrases are found in environmental laws in such profusion that the adjudication of these statutes has centered on their definition. I am certain you will recognize these words or these phrases: "acceptable," "best practicable," "achievable," "reasonable," "generally regarded as safe," "prevailing professional practice," "appropriate tests," and perhaps, the most value-laden of all phrases: "the public interest." These value words become "code words," ignifying a whole set of assumptions. This means, of course, that the food scientist of today must be realistic and recognize, if he can, values or points of view with respect to a situation in which the government evaluator finds himself.

So the modern food scientist must understand this unscientific terminology as a source of some of the present day confusion. Scientific data and facts are frequently overlooked, and science may not be considered as objectively as it is portrayed. This means, therefore, that the food scientist today, in considering environmental matters relating to foods, must not only consider them from a scientific and a legal point of view but also from the point of view of the subjective values involved.

Here is an example of a current environmental problem. This relates to the disposal of solid and liquid wastes. The food scientist today must realize that his organization may well face seriour problems relating to waste disposal. For example, I am well acquainted with a vice president for research of a food organization who has devoted a major part of his time in the past several years to the development of a means of disposing tons of tomato and pear wastes. No sooner was this problem solved than another relating to water pollution resulting from liquid waste disposal confronted him. This is another indication of the expanded

interest and activity forced upon the food scientist as a result of the ever-changing legal environment.

Yes, the food scientist of today must have a broader outlook than when I started or even when I retired. He is involved in a diversity of activities whether his training and orientation have been adequate or not. It means, too, that teaching in this area must change and, indeed, is changing. The field today embodies far more than was visualized by those who started early in this century. It has come a long way, and it will go further for already there are specializations and as time goes on there will be more.

Tomorrow's Food Science

Now about the future. During the past few years, there has been more governmental activity than ever before resulting from the passage of a number of new congressional acts and from increased activity on the part of such agencies as the Food and Drug Administration and the Federal Trade Commission. Then, too, there is on the horizon the Hazardous Chemicals Act. All of these acts, in one way or another, can and will influence the food industry and broaden the activities of food scientists more and more as times goes on.

Congressional Action

Some of the developments as a result of congressional action are:

- National Environmental Policy Act, 1969
- Council on Environmental Quality, 1970
- Environmental Protection Agency, 1970
- Occupational Safety and Health Administration Act, 1970

- Consumer Product Safety Act, 1972
- The Federal Water Pollution Control Act, 1972
- Clean Air Act, 1972
- Energy Supply and Environmental Coordination Act, 1974
- Safe Drinking Water Act, 1974
- Federal Energy Administration Act, 1974
- Federal Insecticide, Fungicide and Rodenticide Act, 1972, Amended 1975

Then, there is the Hazardous Substances Act which was established a good many years ago.

The Toxic Substance Act is in the mill.

The result of all these acts plus the many rules, regulations, standards, decisions, guidelines, and judgments germinated by them, expand and change the whole outlook of a food scientist from one of scientific creativity into one of scientific defensiveness.

Let's consider a few specifics. Air pollution caused by smokestack emissions, the odors escaping from such facilities as a catsup plant, a fermentation vat, an onion drier, or even the pleasant smells of a coffee roaster or a hamburger stand are demanding more attention.

Safe Drinking Water

In 1974 the Safe Drinking Water Act was passed. It directed the Administrator of the Environmental Protection Agency to make and report findings of a comprehensive study of water supplies to determine the nature, extent, sources, and means of control of contamination by chemicals and other substances suspected of being carcinogenic. At first, this appears to be a subject of but passing interest to those involved in the production of foods. Recently, however, there appeared a report on the occurrence of 96 organic

chemicals in drinking water in New Orleans, ranging in concentrations from a few to several parts per billion. Later, a study was made of the situation in several cities throughout the United States and the number of chemicals found increased to 411. There were implications that some of these substances are carcinogen, particularly chloroform, resulting from use of the chlorination process.

Dr. William Stewart, former U.S. Surgeon General, pointed out that the defensive posture has become more commonplace for public health officials in the last few decades because of our ability to detect foreign substances in the environment in increasingly smaller amounts. At the same time, our ability to understand the biological consequences of exposure to these small quantities over long periods of time has advanced slowly and with great uncertainty. This same defensive posture will become more commonplace for food scientists.

A committee was appointed by the Science Advisory Board of the Environmental Protection Agency to study this situation. It made several comments of great interest to the food scientist. In the first place, it pointed out that it is likely that the majority of the drinking water purveyors, and I would say that most food research establishments, too, do not have available sophisticated equipment and trained personnel to provide monitoring of individual contaminants on a routine basis.

One may wonder why I have spent so much time on water, but the facts of the case are that so much water, this same water, may be used in foods. The committee, however, pointed out that attention on water has been focused largely on the concentration of contaminants in drinking water itself. A complete analysis of the problem would also require analytical and chemical data on exposure to those chemicals by ingestion of foods and beverages processed with contaminated water. Then, too, there are possible exposures

resulting indirectly from environmental redistribution and biomagnification of the chemicals by food organisms which consume contaminated water. This is something that I believe will confront food scientists in the future.

I find it interesting that there appears to be three great concerns with respect to water standards and requirements. One, of course, relates to the occurrence of infectious bacteria and viruses, which is of great importance to those in underdeveloped nations. In this country the present great concern appears to be about the presence of toxic organics. I find it of particular interest, however, that in certain parts of the world, particularly in Finland, the importance of naturally occurring inorganic trace elements as water pollutants and their implications in the health of man is of great concern. It has been pointed out that in the United States water softness has shown positive correlations for cardiovascular disease and arteriosclerotic situations. The question is what, if any, concern should this be to the food scientist. This remains to be seen.

Another factor bound to confront the food scientist in the future relates to packaging, for we may be compelled to shift from the use of metal to plastic containers that are safe. Great progress has been made along these lines, but more work appears to be necessary. At present we import approximately one-third of the iron and all of the tin we use from other countries. One can but wonder how long this can go on.

World Food Supply

Then, another area of concern is and will continue to be the world food supply. We are becoming more and more apprehensive about this problem, even to the extent that the White House has asked the U.S. Department of Agriculture

and the National Academy of Sciences-National Research Council to study the matter. In the future there will be more pressure for creative thinking along these lines. In this connection Lord Ritchie-Calder has pointed out that the world population 25 years from now cannot be less than 7 billion. Even now, he has indicated that 400 million go to bed each night with less food than they need. There is so much to do in spite of speculations about new products and formulations.

On the other hand, we seem to worry more and more about safety, whether in reality it should be a matter of great concern. We are refining our methods of analyses, so no longer do we speak only in terms of parts per million but in parts per billion and even parts per trillion. It appears that we may be going so far as to reduce our concerns about safety to the last molecule, and this will, indeed, keep those of us who are worried about the safety of our food in business for a long time—and likewise the food scientist trying to solve the problems relating to this last molecule.

The area of waste is one that will require a great deal of attention, not only from the standpoint of pollution and its prevention, but also from the standpoint of utilization. I have already mentioned tomato and pear wastes, but there are other wastes. For example, work is already underway at the Natick Laboratory of the Defense Department on the conversion of cellulose wastes to sugars by the use of the organism *Trichoderma Viridans.*

Quality In Leadership

I would like now to stress what I believe as time goes on will be a great need, one that will be a most critical need especially in the field of food science, and that is leadership. Scientists, generally speaking, are not prepared to step up and do battle, something that is and will be needed in the

area of food science as well as in other areas. Scientists normally take refuge in the need to do more research rather than in pointing out that there is a calculated risk. Advocates, on the other hand, too often speak with certainty, even in the absence of data to substantiate their statements.

Even though there are a number of methods for extrapolating risk from high doses to lower doses, or from animals to man, scientists are accustomed to working in areas of greater precision, and thus do not want to stake their reputations on estimates, which they consider unreliable.

Advocates and economic scientists, however, have been repeatedly willing to come up with cost estimates of various control strategies designed for various specified levels of control. The result of this is that administrators of regulatory agencies frequently find themselves in situations where they have no quantitative risk estimation of health effects but do have highly unreliable quantitative cost estimates from economists. Paradoxically, it appears to me that if scientists would use the risk estimating methods available, they might well come out with better estimates of risk than those of economists and advocates. Scientists should come out from behind their fortress of scientific certainty and be willing to take the leadership in giving advice based on their expert knowledge.

Another quality of leadership is the ability to be willing to face that most uncomfortable of professional necessities: the ability to be self-critical.

It is mandatory that he, the scientist, be willing to run an experiment to disprove himself and if this is not done, then his data should not be considered acceptable. Likewise, the advocate must be induced to do some thinking to test his ideas and results, a situation that is nonexistent or at least rare, today. The business of the advocate is to win without violating the law; but the business of the scientist is to see that the whole truth is involved in a decision.

Unfortunately, responsible scientists often find it hard to present their views to the press or to political bodies, such as legislators or administrators. As Judge Jerome Framt pointed out:

> *Creative master minds seem to feel a personal aversion to the idea of unfolding before the public gaze the delicate threads of thought, out of which their productive hypotheses were woven, and the myriad of other threads which failed to be interwoven into any final pattern.*

It appears to me that responsible scientists are well aware that perfection in science, and especially in biological science, is a rarity, if at all existent. Realizing this limitation, they testify with uncertainty and always indicate the need for more research. On the other hand, those who may be advocates, biased, ill-informed, or even completely uninformed, testify with a positiveness that leaves no doubt in the mind of the politician or the average citizen. How, then, is the politician or news media to know who is correct and responsible, and who is irresponsible?

In this connection, Dr. William Darby, in his keynote address at the annual meeting of the Canadian Agricultural Chemical Association commented:

> *Matters pertaining to environmental pollution, safety of the environment, safety and quality of foods, pesticides or additives are emotional subjects for many vocal members of our society. Statements pertaining to such subjects attract immediate attention. It is*

particularly important, therefore, that information provided by scientists *to the public be accurate, balanced and objective and avoid creating a sense of alarm where there is no reason for disquiet.*

He also pointed out that the Food Protection Committee of the National Academy of Sciences—National Research Council had taken a position on this matter.

This committee stated:

Standards of conduct of this sort are particularly necessary whenever a scientist, no matter how eminent, moves beyond his area of competence. In the field of toxicology, in particular, there is an increasing tendency for scientists working in a wide variety of disciplines to feel themselves capable of making pronouncements on hazards to the public. Evaluation of the safety of foods and food chemicals demands a specialized background of knowledge and experience without which scientific judgment falls short of what is desirable in the public interest. Public misinformation about food safety is an inevitable consequence of misplaced confidence of scientists in their ability and authority to pass opinions on questions of food safety. The scientific community as a whole has a duty to protect the public from the consequences of misinformation on such vital issues as food and nutrition in relation to health (and to preserve public confidence in science) . . .

This is certainly something the food scientist will have to keep in mind more and more as time goes on.

It must be realized that the image and nature of a person—a scientist—a food scientist—is critical. There is a need for scientists who are articulate and willing to speak in terms of probabilities but with certainty. A paranoiac defensive behavior of a scientist, so common today, is just as deadly as is the refuge in the need for more research. It must be made clear that there are limits to perfection. Lawmakers, implementers, and enforcers must be educated into an understanding of the way in which a scientist who says something is probable, but who refuses to speak in terms of absolutes, is more to be trusted than the biased advocate who speaks with specious certainty. It must be made clear that no one is or can be a perfectionist and that those who speak about perfection are anything but perfect.

Tomorrow's food scientist must be aware of the factors involved in making decisions. These will certainly include science, economics, social factors, political factors, aesthetics, and emotions. Above all, he must realize that, unfortunately, science may often play a minor role. It is the duty of the food scientist in the future to assume the leadership of the country in answering problems of food safety as well as in solving the problems of food quantity and quality.

The Continuing Legacy

Yes, food science has come a long way from the days of its early development by Atwater, Russell, Prescott, Cruess, scientists in the Agricultural Research Service, and others. Times, too, have changed, and the need for scientists who have the quality of leadership and great breadth of thinking and understanding is more apparent than ever. We will

indeed need those who will be willing to take responsibility and go to the lonely outposts of thought and action and to persuade others to follow them there and to act with positiveness, with persuasiveness, with constructiveness, and with certainty. This ability, unfortunately, is the rarest of commodities, but truly one we must develop for the future.

Dr. Emil M. Mrak, an internationally recognized authority on food science and technology, established one of the leading departments in this field at the University of California at Davis. In 1959 he was appointed chancellor of this University which he had helped develop from a small agricultural college into an institution widely known for its school of veterinary medicine, its innovative and developing medical school, its department of biochemistry, and other related arts and sciences.

Born in San Francisco, Calif., he received his B.S., M.S., and Ph. D. degrees from the University of California, Berkeley. He became an instructor of food technology on the Berkeley campus in 1937, the year he received his doctorate. In 1948 he became chairman of the food science and technology department at Berkeley and in 1951 moved with most of the departmental staff to the Davis campus. He was chancellor of the University of California, Davis, from 1959 to 1969.

Internationally, some of Dr. Mrak's expertise in the area of foods led to his selection for service on two Presidential missions designed to examine the food and agricultural policies of the United States with respect to Latin America.

As a food technologist, Dr. Mrak has become increasingly concerned with world food problems. With respect to these problems, he assesses an order of priorities: the need for conclusive safety studies to reassure people of the purity of the food supply, the need for new foods to meet changing food habits, the need to cut food costs and losses and perhaps, most important of all, the need for sound food and nutrition education.

Dr. Mrak is currently chairman of the Science Advisory Board of the Environmental Protection Agency; member of the Commission on Natural Resources, National Research

Council; member of the steering committee of the World Food and Nutrition Study, National Research Council-National Academy of Sciences; and trustee of the Nutrition Foundation.

In 1957 the Institute of Food Technologists (IFT) awarded him the Nicholas Appert Medal; in 1961, the Babcock-Hart Award; in 1963, the International Award. He was the first person to win all three awards. In 1970 he was elected a fellow of IFT. He received the Kenneth A. Spencer Award of the American Chemical Society for outstanding achievement in agricultural chemistry in 1972.

Previous Lecturers and Cosponsoring Organizations

1968 Dr. Artturi I. Virtanen (deceased), Director, Biochemical Research Institute, Helsinki, Finland; Federation of American Societies for Experimental Biology, Atlantic City, N.J., April 16.

1969 Dr. Albert Szent-Gyorgi, Director, Institute for Muscle Research, Marine Biological Laboratory, Woods Hole, Mass.; American Chemical Society, New York, N.Y., September 10.

1970 Dr. Philip Handler, President, National Academy of Sciences, Washington, D.C.; Third International Congress of Food Science and Technology, Washington, D.C., August 11.

1971 Dr. Jean Mayer, Professor of Nutrition, Harvard University; The Second National Biological Congress, Miami Beach, Fla., October 24.

1973 Dr. Marina v. N. Whitman, Professor of Economics, University of Pittsburgh; The American Home Economics Association, Atlantic City, N.J., June 25.

1974 Dr. J. George Harrar, President Emeritus,
The Rockefeller Foundation;
The American Association for the
Advancement of Science, San Francisco,
Calif., February 28.

1975 Dr. William J. Darby, President
The Nutrition Foundation;
The American Dietetic Association,
San Antonio, Texas, October 21.

Agricultural Research Service
U.S. Department of Agriculture
Washington, D.C. 20250

November 1976

GPO 909-585

AMERICAN REVOLUTION BICENTENNIAL 1776-1976